UCRL-JC-124858 Abs

# Wavefront correction for static and dynamic aberrations to within 1 second of the system shot in the NIF Beamlet demonstration facility

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(oral presentation preferred)

*Abstract*

Thermally induced dynamic variations in gas density in the main beam line produce significant wavefront error in the NIF Beamlet demonstration system with temporal correlations of about one second. An adaptive optics system continuously compensates for these aberrations as well as for static aberrations from the beam line. To effectively provide a reproducible shot condition the adaptive optics system must remain in closed loop until one second prior to firing a shot ($t_0$).

In the final second we must protect the wavefront sensor and optical components from the intensity of the shot, while maintaining it as an effective diagnostic of the shot. This requires removing a polarization rotator in the main multipass amplifier and an AR filter in the wavefront sensor and inserting a high-reflector attenuator and a neutral density filter. When done manually, this procedure left the wavefront control system unlocked for about 10 minutes prior to a shot. To automate this process, we installed a very high speed filter wheel, a fast air actuated extractable polarization rotator mount, and a fast air actuated HR/AR insertion/extraction filter mount. These devices complete their activity within 250ms. A CW alignment laser that provides continuous illumination of the wavefront sensor to within 1 second is shuttered prior to the shot to prevent unwanted light in the system at shot time.

The net bandwidth of the adaptive optics system was increased to 3 Hz, which is sufficient to dampen the gas induced aberrations in the main beam line, and a timing system was designed, developed, and implemented to provide $t_0$-1 timing signals to the devices and to the wavefront control system. At $t_0$-1 the wavefront control system receives an enable signal from the timing system, automatically unlocks the control loop, and sets itself up as a $t_0$ wavefront diagnostic. When the mechanical and controller changes are complete, a permissive signal is sent to the amplifier pulsed power system.

We will present a full description of this system. We will also describe the system performance, compare these results to previous results, and discuss how this scheme would be implemented in NIF.

This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under contract No. W-7405-Eng-48.